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Photo by Richard Robinson, IRM-CAS

Nominated by Melvin Borrego (pictured at right), Los Alamos National Laboratory received an Above and Beyond Award for supporting National Guard and U.S. Army Reserve members.

Melvin Borrego

Serving the nation through neutron science and National Guard missions

By Diana Del Mauro
ADEPS Communications

For one year in Iraq, Melvin Borrego drove the lead five-ton cargo truck in convoys that delivered food, ammunition, and other logistical supplies to United States soldiers. On the road, he braced for sniper attacks, ambushes, and home-made bomb explosions. He also provided a secured area for all soldiers at Camp Cook in Taji, a village just north of Baghdad that was under constant mortar attack. He mourned the deaths of five close friends from the Arkansas National Guard.

With life-threatening dangers weighing on his mind, Borrego said he was glad he didn't have to worry about his wife and two children back in Española. "My family was taken care of," said Borrego, of the Lujan Center Neutron Scattering Center (LANSCE-LC). "They had the support of family, friends, the New Mexico Army National Guard Family Support Program, and Los Alamos National Laboratory."

For 16 of the 18 years that Borrego has served with the National Guard, he has worked at the Lujan Center, winning awards in both positions. To show his gratitude to the Laboratory for years of support, Borrego nominated Los Alamos

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> *"I want to make sure everyone knows the Lab is a stong supporter of our civilian soldiers. Without the Laboratory's strong support, we cannot do our jobs and fulfill our obligations in the military effectively."*

"This year a record number of 94 application packages were reviewed—a clear indication of LANSCE's reputation within the neutron community world-wide and the success of LANSCE's past schools."

From Alex's desk . . .

Colleagues,

Let me first take this opportunity to welcome the LANSCE 2013/2014 Rosen Scholars: Professor Devinder Sivia of St. John's College, Oxford, and Dr. Paul Koehler of Los Alamos National Laboratory and Oak Ridge National Laboratory. Professor Sivia is an accomplished lecturer and author focusing on Bayesian methods of data analysis. His work has been published as tutorial volumes in the *Oxford Chemistry Primers* series, in two slim tutorial volumes, on the "Foundations of Science Mathematics" (1999, OUP). At St. John's he has taught "Maths for Natural Sciences" to chemistry and physics undergraduates for a number of years. His research revolves around the application of Bayesian probability theory to all sorts of data analysis problems, mainly in the physical sciences. Dr. Paul Koehler has performed and led groundbreaking research at LANL and ORNL. A guest researcher collaborating in nuclear physics at the University of Oslo in Norway, Dr. Koehler has published 95 peer-reviewed papers and more than 110 additional international conference articles and numerous invited engagements at international meetings. A common thread in all of Dr. Koehler's research, in addition to providing data of importance to basic and applied physics, is experiments aimed at testing and improving nuclear models. As a reminder, the Rosen Scholar is a fellowship created to honor the memory of Louis Rosen, his accomplishments, and affection for the broad range of science performed at LANSCE. The fellowship is intended to attract visiting scholars to LANSCE in the fields of nuclear science, materials science, and accelerator science and technology. For more information on the Rosen Scholar, please visit lansce.lanl.gov/users/rosenscholar.shtml.

The 2013 LANSCE School on Neutron Scattering, to be held October 16–25, will focus on outstanding issues in fundamental and applied earth and geosciences research and materials behavior under extreme environments. The school will provide an overview and training related to neutron scattering techniques such as diffraction, small angle neutron scattering, local structure determination, and neutron reflectometry. Students will become familiar with neutron scattering and how it may be utilized to address fundamental questions in geosciences and materials in extreme environments. This year a record number of 94 application packages were reviewed—a clear indication of LANSCE's reputation within the neutron community worldwide and the success of LANSCE's past schools. The National Science Foundation, New Mexico State University (NMSU), and the LANL Office of Science Program will sponsor 34 students representing 24 U.S. institutions. Anna Llobet (LANSCE-LC) and Heinz Nakotte (NMSU), this year's school directors, and local organizers have done an outstanding job of preparing for such an important and outreaching event at LANSCE. For additional information, please see lansce.lanl.gov/neutronschool/.

Let me also take this opportunity to encourage you to know more and actively participate in the TA-53 WSST. Gary Sanchez (AOT-IC, sanchez_gary@lanl.gov), the current chair, is doing a great job and welcomes our input and participation.

LANSCE Deputy Division Leader Alex H. Lacerda

HeadsUP! A different way of looking at enviromental protection

When a broad-tailed hummingbird built a nest in June, she selected an Oregon grape holly branch that reached across a side entrance walkway to the Materials Science Laboratory (MSL). The building provided protection from harsh sun and rain, but little did she know that the door, just six feet away from her two eggs, was being heavily used by a construction crew installing equipment for new materials chemistry labs on the MSL's second floor. Building custodian John Guillen reported seeing the mama bird to Materials Science in Radiation and Dynamics Extremes (MST-8) Group Leader Anna Zurek, who was instantly moved to act. "I saw how incredibly scared she was," Zurek said. "Unilateral decision: shut the exit unless there's an emergency." Up went orange cones, caution tape, and signs. Cross Connection Inc., the construction contractor, agreed to use a back entrance instead. The next day, Zurek found the mama bird sleeping peacefully. For six weeks, this would be the hummingbird family's home. Mike Lopez, an MST-8 research technician, photographed the chicks hatching, feeding, grooming, and taking first flight. "It's an amazing little bird," said Lopez, who has kept hummingbird feeders in his yard for 10 years, but never seen a nest. "How fast they've grown from one week to another week. I was sad to see them go." As he and Zurek recounted the story of their feathered friends, one of the fledglings fluttered past the abandoned nest. "This was a baby who came back! So sweet!" Zurek said.

Borrego cont.

National Laboratory for the 2013 Secretary of Defense Freedom Award, which recognizes employers for outstanding support of National Guard and U.S. Army Reserve members. Los Alamos received an Above and Beyond Award, but did not advance to the national competition.

"When I was deployed, they went above and beyond," Borrego said. "It's like a family over here—you're not just a number."

Every payday, a member of the group office would call his wife, Angela, to confirm she had received Borrego's Laboratory paycheck, which supplemented his National Guard wages. The Lujan Center and the Laboratory sent care packages of New Mexico green chile, salsa, and beef jerky. "Somebody sent me slippers," Borrego said, "a very nice comfort of home after wearing boots for many hours."

Fortunately, all 103 soldiers of the 1115th Transportation Company of the New Mexico Army National Guard returned home to their families in 2005.

Borrego said he found it reassuring to still have the job he loved at the Lujan Center. He is 1 of 2 technicians for 12 scientific instruments at the national user facility. If something breaks down or needs on-the-spot fabrication on the beam lines, he must react promptly, even if it's at 2 a.m. "It's my job to see that every user and every scientist at the Lujan Center gets a positive experience from a mechanical perspective," he said.

When he enlisted in the U.S. Army in 1991, he was a seasonal construction worker seeking steady work with health benefits for his young family. Borrego, who received a Combat Action Badge and other awards from his Iraq tour, is now a 1115th Transportation Company first sergeant, overseeing operations and training for 126 soldiers in the Taos-based unit. He performs two weeks of annual National Guard training and responds to federal and state emergencies. During the Las Conchas Fire, for instance, his unit spent two weeks providing security in Los Alamos by assisting local police and fire departments.

Whenever Borrego is on military leave, his Lujan Center colleagues step in, ensuring tasks get done and maintenance operations stay on schedule.

Now eyeing military retirement, Borrego is glad Los Alamos National Laboratory received recognition for what it has done for him and all employees in the National Guard or U.S. Army Reserve. Nearly 900 Laboratory workers have military affiliations. "I want to make sure everyone knows the Lab is a strong supporter of our civilian soldiers," Borrego said. "Without the Laboratory's strong support, we cannot do our jobs and fulfill our obligations in the military effectively."

Duke, Shields earn honors at 2013 Student Symposium

In recognition of their research, two Los Alamos Neutron Science Center students received certificates of award at the 13th annual Student Symposium.

In "Total Kinetic Energy Measurements of 235-U and 239-Pu (n,f) Fission Products," poster presentation winner Dana Duke (Neutron & Nuclear Science, LANSCE-NS) sought to improve scientists' understanding of the fission process and provide valuable measurements against which simulations can be benchmarked. Fredrik Tovesson (LANSCE-NS) mentored Duke, a graduate research assistant from the Colorado School of Mines.

Most of the energy released in neutron-induced fission goes into the kinetic energy of the resulting fission fragments. Fission theorists have indicated a need for additional average total kinetic energy (TKE) information at incident neutron energies relevant to defense- and energy-related applications,

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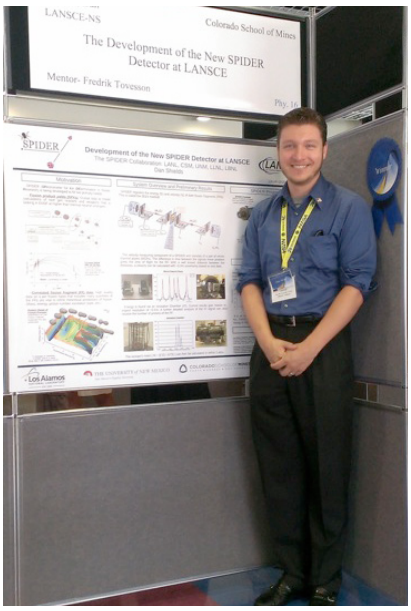

Above, Dana Duke (center) with Los Alamos Institutes Director David Clark (left) and Principal Associate Director Science, Technology, and Engineering Alan Bishop (right).

Right, Dan Shields with his winning poster.

Symposium cont.

as current measurements are lacking. At LANSCE, Duke developed an experiment for measuring the TKE of fission products following the neutron-induced fission of 235-U and 239-Pu over incident neutron energies from thermal to hundreds of MeV. Two independent measurements, one using a double Frisch-gridded ionization chamber, and another employing silicon surface barrier detectors have been prepared for the 2013 LANSCE run cycle.

In "The Development of the New SPIDER Detector at LANSCE," poster presentation winner Dan Shields (LANSCE-NS) showcased a new instrument. He is part of the team developing the spectrometer for ion determination in fission research, which is being constructed at the Weapons Neutron Research facility. Tovesson mentored Shields, a graduate research assistant from the Colorado School of Mines.

Shields presented an overview of the SPIDER's detector components, data acquisition system, simulations, and preliminary test results. Fission product yields (FPY) are crucial to a better understanding of the fission process, with important implications for stockpile stewardship and models of next generation nuclear power. Currently, there is a small and partially conflicting set of FPY experimental results at higher than thermal neutron energies for critical actinides. SPIDER is being developed to create more precise data. The detector will have exceptionally high fragment mass and incident neutron energy resolution, allowing for unprecedented measurements of the FPY directly after fission takes place.

This year's symposium, "Championing Scientific Careers," featured 135 posters and 35 technical talks and was held as part of the Employee Family Celebration. Employee volunteers judged the posters and technical talks.

Tovesson wins Distinguished Mentor Award

Having guided and encouraged nearly a dozen Laboratory students in four years, Fredrik Tovesson (LANSCE-NS) has earned respect for consistently supporting students even after the Laboratory's summer program is over and they've returned to school. He was recently honored with a 2013 Laboratory Distinguished Mentor Award.

According to those he has mentored, Tovesson goes the extra mile to help them understand the fission physics behind their work at the Weapons Neutron Research facility: he draws cartoons on the white board, distributes key background papers, and sets up in-depth meetings. "Fredrik is never too busy to talk to a student about anything," wrote nominator Dana Duke, a graduate research assistant (LANSCE-NS). "Although he is the PI on multiple experiments, is a flight path scientist at LANSCE-Weapons Neutron Research, and has two postdocs, Fredrik is always willing to talk about physics, answer career questions, or sometimes just chat."

Another nominator, graduate research assistant Dan Shields (LANSCE-NS), credited Tovesson with giving him and other students valuable projects on which to work, leading to publications that help develop their professional careers. Shields also gained a better understanding of the non-technical aspects of a researcher's career by attending monthly fission team meetings, at which Tovesson gathered all the students and postdocs at LANSCE-NS.

Duke said she found her career direction under Tovesson, who was her mentor for three years. She came to Los Alamos in 2010 as a junior in college with no background in nuclear physics, but after "a summer of rich, rewarding experiences, I started to believe that maybe I found my passion in life." Duke returned to LANSCE every summer, and now is working on her PhD thesis at Colorado School of Mines.

"When the summer is over, (Tovesson) reaches out to students during the year, encouraging us to be successful and come back to the Lab," said Duke. "Fredrik is vital to LANL's mission by training the next-generation workforce."

The LANL Student Program Advisory Committee selected five 2013 Distinguished Mentor Award winners.

Adam T. Holley wins 24th Rosen Prize

Adam Holley, a postdoctoral fellow at Indiana University, won the 24th Rosen Prize. The $1,000 prize, established in honor of Louis Rosen, the father of LANSCE, is awarded for the most outstanding doctoral or master's thesis based on experimental or theoretical research performed at LANSCE. Selection criteria include the originality and scientific impact of the research and the student's contribution to the research.

Holley's doctoral thesis, "Ultracold Neutron Polarimetry in a Measurement of the β Asymmetry," describes techniques to allow in situ measurements of the neutron polarization in the Ultra-Cold Neutron A (UCNA) experiment at LANSCE.

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The method shows an order of magnitude increase in sensitivity, which could have important ramifications for other low-energy fundamental physics measurements. Holley presented an invited talk for the UCNA Collaboration at the 7th International UCN Workshop in Saint Petersburg, Russia, and he has contributed talks for the UCNA collaboration at American Physical Society meetings. Holley received a PhD in nuclear and particle physics at North Carolina State University, where Albert Young advised and mentored him for the LANSCE research.

The UCNA Collaboration includes Subatomic Physics (P-25), Neutron Science and Technology (P-23), and external collaborators (North Carolina State University, California Institute of Technology, Virginia Tech, University of Washington, and Idaho State University). The LANSCE accelerator is an integral capability in the experiment.

Technical contact: Alex Lacerda

Elena Fernandez wins APEX award

For her work on the 2012 LANSCE School on Neutron Scattering, Elena Fernandez (LANSCE Division Office, LANSCE-DO) has received a 2013 APEX Award of Excellence. The school's design materials were entered in the Special Purpose Campaigns, Programs & Plans category of the annual communications awards competition, sponsored by the editors of *Writer's Web Watch* and the *Writing that Works Archives*.

The 2013 competition included approximately 2,400 entries, of which 100 Grand Awards and 971 Awards of Excellence were presented.

Fernandez, a senior public information specialist deployed from New Mexico State University, has worked with LANSCE since 2010. She has won previous APEX Awards for her work on the 2011 LANSCE School on Neutron Scattering and the 2010 LANSCE Activity Report. This is her seventh APEX Award of Excellence. For more information, see www.apexawards.com.

Neutron reflectometry reveals helium bubble formation in radiation resistive materials

Management of implanted helium (He) is crucial to the development of new fusion and fission reactor materials. Because of its insolubility in crystalline metals, implanted He immediately precipitates into 2–3-nm-diameter bubbles. Unlike He-free cavities, these bubbles are thermodynamically stable and are effective nuclei for the growth of larger voids, which in turn accelerate radiation-induced swelling and high-temperature embrittlement of grain boundaries. The current approach to reducing the deleterious effects of He in structural materials is based on delaying the so-called "bubble-to-void" transition. By reducing the concentration of radiation-induced vacancies and increasing the density of bubble nucleation sites, the critical fluence of implanted He required to transform stable bubbles into voids may be maximized.

Neutron reflectometry (NR) at Lujan Neutron Scattering Center at LANSCE has been used to find the critical He fluence required to form He bubbles at interfaces between fcc and bcc metals. Due to the excellent neutron scattering contrasts between investigated metals (Cu, Nb, Mo and V), reflectometry is well suited to address the changes in the structural properties of such interfaces upon interaction with implanted He. The findings, published in *J. Appl. Phys.*, are in agreement with previous experimental as well as modeling results and provide evidence for the presence of stable He platelets at fcc-bcc interfaces prior to bubble formation. The stable storage of He in interfacial platelets may provide

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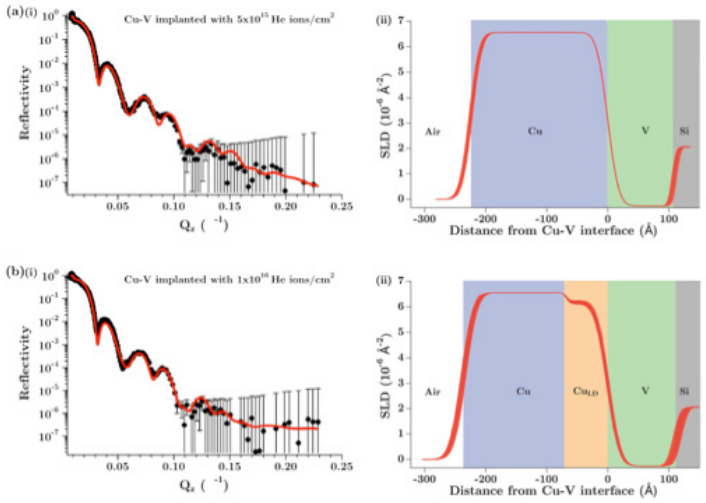

Figure 1. (a)-(b)(i) NR data (filled circles) from He implanted Cu-V bilayer samples and fitted curves (solid red lines). (a)-(b)(ii) SLD profiles from which the NR fits were obtained along with schematics of their interpretation in terms of composition.

Bubble cont.

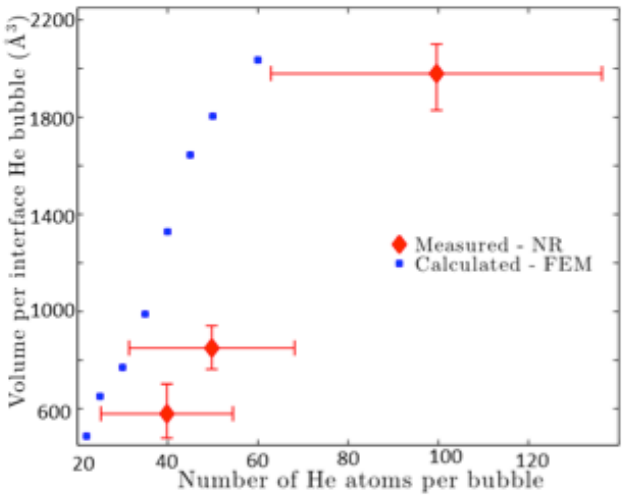

Figure 2. Red diamonds—volume per He bubble at Cu-Nb interfaces determined from NR data. Blue squares—volumes of stable interfacial He bubbles calculated from a reaction-diffusion model using finite element method.

the basis for the design of novel materials with increased resistance to He-induced degradation.

For this work, Abishek Kashinath, a PhD candidate from the Massachusetts Institute of Technology (MIT), who is currently with the Center for Integrated Nanotechnologies (MPA-CINT), received the Best Student Talk Award during the Department of Energy Office of Science 2013 Energy Frontier Research Centers PI meeting in July in Washington, DC. The citation highlighted use of neutron scattering to confirm his previous numerical calculation.

Reference: "Detection of helium bubble formation at fcc-bcc interfaces using neutron reflectometry," A. Kashinath (MIT); P. Wang, J. Majewski (LANSCE-LC); J. K. Baldwin (MPA-CINT); Y. Q. Wang (Materials Science in Radiation and Dynamics Extremes, MST-8), et al., *J. Appl. Phys.* **114**, 043505 (2013); doi: 10.1063/1.4813780.

This work was supported by the Center for Materials in Irradiation and Mechanical Extremes (CMIME), an Energy Frontier Research Center funded by the US Department of Energy, Office of Science, Office of Basic Energy Sciences under Award No. 2008 LANL1026. This work also benefited from the use of the Lujan Neutron Scattering Center at LANSCE, funded by the DOE Office of Basic Energy Sciences and Los Alamos National Laboratory under DOE Contract DE-AC52-06NA25396.

Technical contact: Jaroslaw (Jarek) Majewski

Stimuli responsive coating layers of medical importance

Stimuli responsive mesoscale systems are of great potential for many applications, e.g., in material science for sensing molecular architectures, creation of medical nanodevices, molecular electronics, permselective membranes/scaffolds, and the bottom-up fabrication of functional molecular devices.

However, their fabrication poses many engineering challenges. Frequently, employed preparation techniques result in incomplete structures of limited functionalities, which are too fragile to sustain significant mechanical stress or to endure changing environmental conditions required for most practical applications.

Structures of importance include ultra-thin coating layers, which are friendly towards biological objects, e.g. cells, and can be easily applied and manipulated. Imagine a way to grow artificial tissue, or a layer of stem cells, of macroscale dimension that have the ability to be easily detached from a

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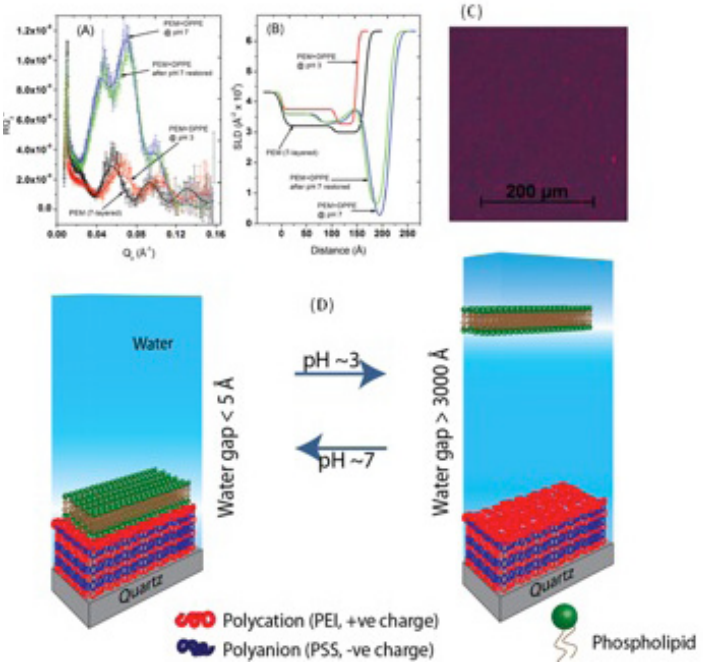

Polyelectrolyte multilayers as a platform for pH-responsive lipid bilayers. (A) Neutron reflectivity profiles and corresponding (B) scattering length density profiles of lipid bilayer deposited on PEM revealing that the separation distance between the polymeric cushion and the DPPE bilayer can be reversibly adjusted by varying the pH of the aqueous environment. (C) Fluorescence micrographs of lipid bilayer deposited on PEM showing intactness of the lipid bilayer in acidic environment. (D) Schematic depicting the pH responsiveness of the bilayer deposited on a polymeric cushion.

Stimuli cont.

support and applied into malfunctioning organs! Or, envision self-cleaning surfaces that can shed any unfavorable residues via application of an external stimulus.

Scientists from the Lujan Center at LANSCE were able to fabricate such stimuli responsive mesoscale films: thin lipidic membranes that could reversibly be de-attached from polymeric cushions by changing the environmental conditions. Neutron reflectivity and other complementary techniques showed that decreasing the pH of the surrounding liquid separated the lipidic film and the polymeric cushion due to electrostatic repulsion. Returning to the original pH reconstitutes the initial configuration, with little or no change in the film structure.

Hence, they were able to create a free-floating lipid film (sheet of self-assembled lipid molecules of many cm^2 in the lateral dimension, but only couple of nanometers thick) that can serve as a platform for many bio-applications. For example, a sheet of cells could be fabricated on such polymeric cushions and efficiently be transferred to an implant for better immune-acceptance.

As another possibility, tubes could be coated with such films making them self-cleaning. Such stimuli responsive free-floating films are not only of interest for smart materials, but also for the study of biomembranes and associated proteins, which is very important for drug targeting or designing new types of antibiotics.

In work published in *Soft Matter*, Lujan Center scientists Ann Junghans, Saurabh Singh and Jarek Majewski, in collaboration with Jianhui Tian and S. Gnanakaran (Theoretical Biology and Biophysics, T-6) as well as Jerzy Chlistunoff (Materials Synthesis and Integrated Devices, MPA-11), used a combination of techniques to understand the reversible pH-responsive behavior of lipid bilayers deposited on polyelectrolyte multilayer (PEM) cushions. Structural characterization using neutron reflectivity revealed that the separation distance between the polymeric cushion and the lipid bilayer can be reversibly adjusted by varying the pH of the aqueous environment.

These observations were further supported by fluorescent microscopy, electrochemical impedance spectroscopy measurements and molecular dynamics simulations. Experimental and modeling results suggest that coulombic forces play a key role in affecting the separation distances between the polymeric support and the lipid bilayer.

This novel system offers great potential for fundamental biophysical studies of membrane properties decoupled from the underlying solid support, but also is a promising tool for tissue engineering applications.

Reference: “Polyelectrolyte Multilayers as a Platform for pH-responsive Lipid Bilayers,” *Soft Matter*, DOI:10.1039/c3sm51651b.This work benefited from the Lujan Neutron Scattering Center at Los Alamos Neutron Science Center funded by the DOE Office of Basic Energy Sciences and LANL under DOE Contract DE-AC52-06NA25396.

Technical contacts: Jerzy Chlistunoff and Jaroslaw (Jarek) Majewski

Celebrating service

Congratulations to the following LANSCE and AOT Divisions employees celebrating service anniversaries recently:

Eric Bjorklund, AOT-IC	35 years
Clifford Fortgang, AOT-HPE	25 years
Claude Conner, AOT-MDE	20 years
Alexander Laptev, LANSCE-NS	5 years

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